DOCUMENT RESUME

ED 155 131 SP 012 459

AUTHOR Egelston, Richard L.
TITLE Identifying Learning Disabled Children.
INSTITUTION State Univ. of New York, Albany. Educational Research and Service Center.
PUB DATE Mar 78
NOTE 40p.; Paper presented at the Annual Meeting, American Educational Research Association (Toronto, Canada, March 27-31, 1978)

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS Grade 1; Grade 3; Information Processing; *Instrumentation; Intelligence Level; Language Ability; *Learning Disabilities; *Predictive Measurement; *Predictive Validity; *Primary Education; Reading Ability; *Screening Tests
IDENTIFIERS Mathematics Ability

ABSTRACT

Screening batteries for the identification of learning disabled children in grades one and three were validated for a pooled group of students from an urban, a suburban, and a rural school. Predictor batteries of individually administered instruments were able to classify students into low achievers and others on several criterion variables (intelligence, reading and mathematics ability, language ability, development, information processing) using any of several definitions of low achievement. Discriminant analyses were able to reduce the predictor batteries to three or fewer instruments in several analyses. Analyses of variance and covariance confirmed the effectiveness of the selection process. Prevention and early intervention of learning disabilities may be facilitated. (Author/MJB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED155131

Educational Research and Service Center

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Richard L. Egelston

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND THE ERIC SYSTEM CONTRACTORS."

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

SP012 459

THE UNIVERSITY AT ALBANY
STATE UNIVERSITY OF NEW YORK

Identifying Learning Disabled Children

by

Richard L. Egelston

Presented at the AERA Annual Meeting in

Toronto, Ont. March 28, 1978

CENTER FOR RESEARCH

Prepared and reproduced in the U.S.A.

This investigation was performed to establish the validity of two screening batteries, and to identify a subset of instruments which could be used to predict which children would be classified as learning disabled by the end of grades one and three.

The identification of children with specific learning disabilities has been, and continues to be, a difficult task for classroom teachers without special training. Children with learning disabilities typically experience difficulty in learning some things, and as a result their achievement is often lower than it should be, based upon their intelligence level. There are several possible explanations for why children achieve at a lower than expected level, and each suggests a different treatment for remediation. It therefore becomes important for the teacher to be able to correctly classify the child according to the reason for the achievement deficit. While some specific learning disabilities may be easily detected under certain circumstances, others must be inferred after all competing explanations have been eliminated from consideration.

The education of children with handicapping conditions depends upon the quality of instructional programs in the schools, as well as sufficient public fiscal support. While many educators would agree that the schools have, for the most part, succeeded reasonably well with the academically oriented, problem-free children who have the ability to do acceptable grade level work, it is commonplace that they have not enjoyed equal success in meeting the needs of exceptional

methods of imparting a quality education to students whose responses to traditional type instructional programs have been less than desirable.

Most educators, health care providers, social workers, and knowledgable policy-makers agree that early identification of learning problems and subsequent structuring of instructional programs tailored to fit each child, provide the best opportunity for meeting the lifelong needs of learning disabled children. Empirical studies have demonstrated an inverse relationship between tardy discovery and degree of educational success.

Keogh and Becker (1973) assert that the sooner the identification of learning disability problems, the more effective will be the treatment program. There is an increasing consensus in support of the assertion that preventive measures should be increased, at the same time reducing reliance on isolationist special education. Traditionally, special education classes have been set apart from regular classes, and the results appear to have been less than salutary.

Over the past twenty-five years, the study of learning disabilities has received an increasing amount of attention from medical, psychological, and educational researchers. Several theories concerning the cause(s) of learning disabilities have appeared in recent years. One of the more prevalent views is the perceptual deficit theory articulated by Cruickshank (1972) who states that "learning disabilities are essentially and almost always the result of percep-

tual problems based on the neurological system" (p. 383). Remediation efforts based upon this theory focus upon specific perceptual motor skills believed to be prerequisite to higher order learning. Seldom is any remediation effort aimed at the academic achievement patterns of the children.

Another view of remediation of learning disabilities is the preferred modality theory. This theory says that one sensory modality overshadows the others to the extent that learning takes place mostly (or solely) through one modality (Chalfant and Flathouse, 1971). Remediation focuses on either the weak or the strong modality and the assumption is made that stimulation of either will result in an integration of information from both. Research efforts have not supported this hypothesis (e.g. Jones, 1971).

Birch (1962) presented a theory indicating that learning disabled children are unable to integrate information from their sensory systems. The evidence concerning this theory remains equivocal, but some support can be found from Beery (1967).

While the three theories above are predicated on disorders within the child, another set of theories concentrates on the inadequacies in the school or environment of the child. Vellutino (1977) has recently reviewed the literature concerning dyslexia and found that research evidence does not overwhelmingly favor a single explanation, but leans toward deficiencies in verbal processing as the best current explanation. By treating dyslexia as errors in semantic encod and/or as

difficulties in rotrieval from verbal memory. Vellutino et. al. (1974) suggest that remediation can focus on specific teaching activities which can take place in the classroom. The focus for the remediation can be on the curriculum, the learning environment, and/or the style of teaching (Gallagher, 1973).

According to Meier (1973), "There is no universally accepted definition of learning disabilities either generically or specifically. . ." However, "children with specific learning disabilities exhibit a disorder in one or more of the basic psychological processes involved in understanding or in using spoken or written language. These may be manifested in disorders of listening, thinking, talking, reading, writing, spelling, or arithmetic" (Chalfant and Scheffelin, 1969). The children possessing these disabilities are of average or above average intelligence and without severe hearing or vision loss, severe emotional disturbance, and free from drug-induced states. A modification of this definition has also been adopted by PL 94-142, the Education for All Handicapped Children Act of 1975.

PL 94-142 mandates a "least restrictive envrionment" for all handicapped students. Learning disabled children will likely be mainstreamed for most of their educational time, and it is imperative that the regular classroom teacher be able to identify and remediate the learning disabilities of this group of children. Since remediation will take place in the traditional classroom, it is important that instruments be found that can identify children who have serious le- -ing diffi-

culties in this same setting. Furthermore, it is also important to be able to predict which children will develop these learning disabilities.

Efforts to predict future success in academic subjects have tended to use multiple regression procedures with achievement pretests and ability tests as predictors, and achievement tests as criteria. When the task has been to identify learning disabled children, or to predict which children will become learning disabled, perceptual-motor tasks have often been added to the predictor battery. The fact that early screening for learning disabilities is done with children who are preschoolers or are in the early grades, coupled with the fact that some of the most commonly used tests are individually administered has required an inordinate amount of time spent on testing children. A reduction of the testing time and the number of variables to a more managable size has often been attempted with a multiple regression analysis in order to identify skills and to maximize the predictability of achievement scores at a later date (Stevenson, Parker, Wilkinson, Hegion, and Fish, 1976).

The variables identified by multiple regression techniques for maximizing the relationship between the predictor battery and the criterion variables are not always those which answer the questions necessary for planning individual programs. It is often more worthwhile to identify those variables which can maximize the split between subgroups; the group needing treatment from the group not needing treatment. Since PL 94-142 mandates treatment for all students who

are handicapped (and provides some funds for this treatment) it is necessary to find a means which will identify the treatment group of students in an optimal fashion. The discriminant function is one statistical technique which can be used to identify subgroups efficiently as has been demonstrated by Satz, Taylor, Friel, and Fletcher (1977) in a study of reading disabilities. The variables identified by the discriminant functions are more properly used than those identified by multiple regression techniques for constructing a screening battery.

As a further aid in reducing the time involved in testing, it is desirable to conduct a prescreening. Teachers can often identify children who are performing at or above the expected level.

Subjects

Seventy-three third grade children and 80 first grade children from three school districts in a Northeastern U.S. SMSA were intially used as subjects in this study. One district was a small city in which two schools out of six were target schools; another district was a suburban school district in which all four schools were target schools. The third district used was a rural district in which one of two schools served as the target school. The three districts were in separate counties, and were not neighboring districts to each other.

Within each district, two subsets of children were identified for each grade. The first was a subset of 10 children randomly selected from the pooled class rosters in the target school buildings. A total of 30 children were randomly selected during the first week of October,

1976, in each district. One third grade and four first grade students in these groups left the district prior to the end of the investigation. One third grade student was not completely tested. These six students were eliminated from the study.

The second subset of students for the two grades was composed of children referred by the teachers. During the first week of October, each teacher was given a form which asked the teacher to name all of the children in the class who appeared to be average or above average in ability, and whose achievement appeared significantly below grade level in reading, language comprehension, or mathematics. Teachers were free to nominate as many children as they desired, or not to nominate any at all. The teachers were asked to exclude from consideration any child who had: a) severe emotional problems, b) gross physical or neurological disabilities including vision and hearing, c) been on medication for an extended period of time (e.g. for hyperactivity), or d) a very bad attendance record due to illness or truancy. The categories for exclusion were not further defined for the teachers. Each teacher was also asked to indicate the achievement area(s) in which the child was deficient.

All students were pre-screened with two intelligence tests, and those who scored less than 90 on both intelligence tests were not included in the study. Forty-three third grade children and 50 first grade children were accepted for the study; however, one third grade child and four first grade children in this group left the school district prior

to the completion of the study, and were eliminated from consideration. One student did not complete the testing program and was also removed.

Procedures

Screening batteries were individually administered to students in both grades during November through January by four examiners, with each child requiring three to five hours of testing spread over several days. The third grade screening battery yielded ten variables: six from commercially available instruments, and four from locally developed instruments. The six commercial instruments used were: Slosson Intelligence Test for Children and Adults (IQ), Peabody Picture Vocabulary Test (IQ), Gilmore Oral Reading Test(Accuracy score), Illinois Test of Psycholinguistic Abilities (Grammatic Closure score), Key Math Diagnostic Arithmetic Test (Total score), and the Bender Visual Motor Gestalt (Number of errors). The locally developed tests used were: Bryant Test of Phonic Skills (Total score), Word Association Task (Total score and Mean Latency score), and the Matching Task (Total score). During May, 1977, each student was administered subtests dealing with mathematics and reading, from the Iowa Tests of Basic Skills.

The first grade screening battery consisted of 12 predictor variables: six from commercially available instruments, and six from locally developed instruments. The commercial instruments used were: Slosson Intelligence Test for Children and Adults (IQ), Peabody Picture Vocabulary Test (IQ), McCarthy Scales of Children's Abilities (Verbal Memory I score), and the Illinois Test of Psycholinguistic Abilities (Grammatic Closure score). Locally developed tests used were: Inve of Develop-

mental Tasks (Copying, Matching, and Total scores), Word Association Task (Total score and Mean Latency score), Matching Task (Total score), Mathematics Screening Battery (Total score), Reading Screening Battery (Total score), and a Trial Teaching Task (Words score and number of trials). During May, the first grade students were also administered selected subtests involving reading and mathematics from the Iowa Tests of Basic Skills.

Analyses of variance (school district by selection process) indicated significant differences between the selection processes ($p < .05$) for none of the 14 variables in grade three and on 13 of 20 variables for grade one. The same analyses of variance indicated significant differences among districts on three of 14 variables for grade three and on six of the 20 variables for grade one. However, only one of the 34 dependent variables yielded a significant interaction (Grade 1 MATH).

Since the purpose of the study was to create a screening battery which could be used on a regional basis, and since it was desired to include as wide a range of scores as possible for each variable, all subjects within each grade level were pooled together.

Operational definitions of potential learning disabilities were created from subtest performance using the Iowa Tests of Basic Skills. Cut-off scores on national norms which were equivalent to 1, 1.5, and 2 standard deviations below the mean were used to classify students either as learning disabled or as not learning disabled. Discrimnant analyses were then performed using various combinations of predictor variables

to determine how well the membership of the two groups could be recovered. The same requirements were used for all discriminant analyses: a stepwise selection of variables which maximized the minimum Mahalanobis distance between group centroids, prior probabilities of group membership were set proportional to group size, and standard program values were used for tolerance and for selecting or deleting a variable from the set of predictors comprising the discriminant function. All analyses were performed with the SPSS version 6 program (Nie et. al., 1975) using the University at Albany computer facilities.

Results

The means and standard deviations for the pooled groups on each variable are reported in Tables 1 and 2 for grades three and one respectively.

- - - - - - - - - - - - - - - - - -

Insert Tables 1 and 2 about here.

- - - - - - - - - - - - - - - - - -

The mean scores on the IQ tests were above the national averages for both grades, but the achievement test score means were below national averages on those achievement measures which report national norms in grade equivalent form. Both results tend to confirm the effectiveness of the identification procedures: selecting out children of low mental ability, and selecting in children who are achieving below expectation. The random sample of approximately 40% was not large enough to obscure the achievement deficiencies in the teacher-referred sample.

The cutoff scores selected for three operational definitions of learning disability for a series of achievement test variables was made by using the end-of-year norms on the ITBS. However, since means and standard deviations of raw scores are not published in the manuals, it was necessary to convert raw scores to grade equivalents, and grade equivalents to percentile ranks. The raw scores which approximated percentile ranks of 16, 7, and 2, were used as the closest values to standard deviations of -1, -1.5, and -2 respectively. Column 1 of Tables 3 and 4 report the percentile ranks for the cutoff scores used. Unfortunately, they are not the same for the four variables used in grade three (Vocabulary, Reading, Mathematics Concepts, and Mathematics Problems) or for six variables used in grade one (Vocabulary, Word Analysis, Reading, Spelling, Mathematics Concepts, and Mathematics Problems). Column 2 of Tables 3 and 4 indicate the variable used as the criterion of definition for the discriminant analyses. Column 2 also indicates whether or not the cutoff score was below chance, when chance was based upon answering all items in a random manner (no students were observed answering in an apparent random manner).

- - - - - - - - - - - - - - - - - -

Insert Tables 3 and 4 about here

- - - - - - - - - - - - - - - - - -

Columns 3 and 4 respectively indicate the number of students who were below (LD) or above (not LD) the cutoff score. The size of the LD group was less than the Not LD group in all cases, and in most cases it

was substantially smaller. The analyses which were performed on those groups with three or fewer members cannot be considered very important due to the uniqueness of the individuals' errors of measurement.

Column 5 of Tables 3 and 4 reports the normalized separation of the two group centroids which were defined by the variables selected by the discriminant function. In all but one analysis, the groups are separated by at least one standard deviation. In most analyses, the separation of the group centroids increases as the cutoff scores decrease.

Column 6 displays the significance level for Wilks' lambda which indicates that for all but two of the analyses, the set of predictors produces a significant amount of information to separate the two groups. The two analyses in which $p > .05$ have very small group membership in the LD group.

Column 7 reports the variables selected from the screening battery in the order of their contribution to the discriminant function. Each variable selected contributed a significant amount over the previous set of predictors. For grade three, four or fewer predictors were identified in eleven of the 12 analyses. Of the variables which could be selected for constructing a screening battery, the best choice appears to be a combination of the Peabody Picture Vocabulary Test, the Gilmore Oral Reading Test, (Accuracy score), the Illinois Test of Psycholinguistic Abilities (Grammatic Closure test), and the Key Math.

For grade one, a larger number of predictors contributed a significant amount to the discriminant function. From these variables, the

most useful appear to be Slosson IQ, Inventory of Developmental Tasks, Word Association Test, Mathematics Screen, and the Reading Screen.

The magnitudes of the canonical correlations reported in column 8 range from .254 to .749, with most being in the .4 to .6 range. These values generally reflect an amount of dispersion providing considerable overlap between the groups. This result is duplicated by the percentage of correct classifications from the predictor set (column 9). The percentages of the non-LD group which are correctly classified are generally in the upper 90s, but the percentage of the LD group correctly classfified is substantially lower. The accuracy in identifying third grade students decreases with using a more extreme cutoff score, while the accuracy in identifying first grade students remains about the same.

The IDT was over-represented in the discriminant analysis for grade one, since both part scores as well as the total score (the sum of the two parts) were entered. Some of the discriminant functions selected one, two, or even all three IDT scores. For example, the analysis for Mathematics Problems (PR = 5) selected one part score and the total score!

In order for the screening battery to be useful in the schools, the set of variables should not only be able to discriminate between the groups of students who will achieve or not achieve well at the end of the year, the set of variables should also be good predictors for the set of variables. That is, the battery should be useful in predicting scores along a continuum, as well as in predicting a dichotomy. With

this in mind, the two reduced sets of variables were subjected to a regression analysis as predictors for each one of the ITBS subtests. Tables 5 and 6 report summaries of these analyses for grades three and one respectively.

- - - - - - - - - - - - - - - - - -

Insert Tables 5 and 6 about here

- - - - - - - - - - - - - - - - - -

Within these tables, columns 1 and 2 are self-explanatory. Column 3 reports the increase in the multiple correlation coefficient as each variable is added to the previous set of variables (reading from top to bottom in column 2). Thus, the multiple correlation for the set of predictors is the bottom entry in column 3 for each analysis. Column 4 of Tables 5 and 6 indicates the additional amount of variation explained by the variables as they are added into the multiple regression analysis, and column 5 reports the respective beta weights for the set of variables after all have been included. Column 5 also indicates the level of significance of the test to see if the slope is significantly different from zero.

The results of the analyses of variance which partitions the sum of squares into that predicted by the regression line and the residual sum of squares is reported in columns 6 and 7.

Due to the small sample size in each grade, and due to the number of predictor variables used in the regression equation, the multiple correlation is slightly biased. An unbiased estimate of the multiple corre-

lation squared is presented in column 8 for each analysis. These values report the proportions of variance in the dependent variable which is predicted by the battery, and ranges between .40 and .55, with most values being close to .50.

The reduced set of predictors were reinserted into the discriminant analysis to determine how well the entire new set of predictors was able to classify the same students, and to create the coefficients of the variables which could be used for classification purposes. The group size, new separation, significance level for Wilks' lambda, canonical correlation, and percentage correct are reported in Tables 7 and 8 for both grades. In addition, Tables 7 and 8 report the percentage of the LD and non-LD groups correctly classified, along with the discriminant coefficients.

- - - - - - - - - - - - - - - - - -

Insert Tables 7 and 8 about here

- - - - - - - - - - - - - - - - - -

Comparing the results in Tables 7 and 8 with the results in Tables 3 and 4 demonstrates that the reduced batteries lose very little in discriminating power. The group centroid separation and level of significance for Wilks' lambda remain approximately the same for most analyses. The canonical correlations have a tendency to drop slightly, but the percentage of correct classification of both groups remains nearly the same.

Discussion

Although both screening batteries included two measures of intelligence, only one was considered important in the selection of variables for the

new battery in each grade. Since the definition of learning disabilities excludes those students with low mental ability scores, some measure of intelligence should be retained in the final batteries. For grade three the PPVT was selected by the discriminant function and was retained on that basis, although the regression analyses indicated that the PPVT was a major contributor in predicting the variability of the ITBS Reading and Vocabulary scores. This result was expected since the PPVT can be considered a measure of receptive language.

For grade one, the Slosson Intelligence Test was more frequently identified in the discriminant analyses than was the PPVT, and was selected for the new screening battery. In addition, it was an important predictor for the regression analysis with the ITBS Word Analysis subtest.

Initially both batteries included measures of knowledge of mathematics. These were identified as important variables by the discriminant analyses, and became important predictors in the regression analyses. The Key Math was retained for grade three and the Mathematics Screening Battery was retained for use in grade one. ~~Both are diagnostic tests~~.

The Accuracy score from the Gilmore Oral Reading Test and the Reading Screening Battery were retained from the original batteries for grades three and one respectively. They were also important predictors in the regression analyses.

For grade three, one additional measure was retained in the new screening battery. The Illinois Test of Psycholinguistic Abilities (ITPA)

Grammatic Closure subtest was a frequently indentified variable in discriminating among learning disabled and not learning disabled groups of students, and was particularly effective for identifying the very low achieveing students. However, the ITPA was not an important variable in the regression analyses. Since it appears to function as a dichotomous variable, and appears to have little relation to reading and mathematics variables, it was retained in the battery. Although measures of language skills were not included on the end-of year testing program, the results of the ITPA test suggest that such measures be included. The ITBS contains subtests for language proficiency.

The Bryant Test of Phonic Skills, Bender Visual Motor Gestalt, Word Association, and Matching Tests were shown to be of relatively minor importance in the discriminant analyses, and were dropped from further consideration in grade three. Their elimination, along with the Slosson, saves approximately 50% of the time in the screening process. However, if the tests were to be administered for some other purpose, then the variables should be entered into the regression equation in order to gain a little extra precision for the predicted scores.

For grade one, the commercially-available McCarthy Verbal Memory test and the ITPA were eliminated from consideration. Thus, only "locally" developed instruments (except for the IQ test) were selected as an early screening battery. The canonical correlations of the sets of variables identified by the discriminant analyses for grade one were generally higher than those for grade three, but when the variables were further reduced in number to create a new battery, the adjusted multiple corre-

lations were slightly lower than for grade three. The reduction in testing time by eliminating several variables from grade one will approximate 25%. Neither subtest of the Inventory of Developmental Tasks (IDT), nor the Word Association total score produced a significant contribution to any of the prediction equations, but they were useful in identifying group membership.

While the variables selected for both screening batteries produce useful results under the definitions considered in this study, a new selection of variables might very well be called for by other groups of schools. In this investigation , there were three levels of cutoff scores used on a number of dependent variables. The selection of variables reported above were chosen to represent the 12 discriminant analyses for grade three, and the 18 analyses for grade one. The assumption by a potential user that the screening battery will produce consistent results across all cutoff scores and all variables is tenuous, at best. Furthermore, the specific subtests traditionally used to identify learning disabled children for the purposes of program planning may produce a different pattern of results if administered at different times during the year. Unless all children make the same relative gain or loss between May and the following September, the groups of learning disabled students will contain different members.

If a school district wishes to limit its consideration of learning disabilities to only the reading comprehension and mathematics concept dimensions of academic achievement, then the batteries identified by this study will still be appropriate. However, if reading comprehension

and matnematics concepts were measured by tests other than the ITBS, there is no guarantee that the screening batteries would be equally effective. While it might be tempting to use the ITBS after it has been administered at a different time of the year, such as in October, other difficulties are presented. At best the screening battery would have concurrent validity, and if parallel forms of the achievement tests were given at the end of the year, practice effects could come into consideration during the second year.

Although the screening batteries were not tested at cutoff levels which are unreported, they would probably function fairly well with different ones. However, new coefficients for the equations used in classifying the students would have to be generated.

While the selection of a cutoff score for identifying learning disabled children is a policy decision for school district administrators, there are certain guidelines which can be followed in making the decision. The first guideline is to use the screening battery as a screening battery. Rather than using the battery to make definitive judgments about classifying children into the LD ot not LD groups, the battery should be used primarily as a guide for further medical or psychological testing. Estimates of the percentage of the school age children who are learning disabled range from 2 to 40 percent with a median of 7 (Murray, 1976), and depend primarily upon the subjective judgments of the person doing the classifying. However, there are many reasons for a child performing poorly in school, and to lump them all into the category of learning disabled seems spurious. To select the lowest 16% in each achievement

area seems excessive, and may waste time and money. At the other extreme, to use a screening battery which would identify only the two or three percent who are at the low extreme on an achievement test may miss several cases of legitimate learning disabilities (these students score below chance). Therefore, it is suggested that the ~~user~~ users select the set of coefficients which identifies the lowest seven percent (approximately) on the appropriate tests, and to conduct further data collection upon this group of people.

One of the problems to consider when using any screening battery is that of misclassification. The false negatives are the group of most concern, since the lack of special programs for those who need them will almost guarantee failure. The false positives who are placed in a special program that they do not need will suffer little in comparison to the others. Hence, the screening battery should err somewhat on the overidentification side. Further testing and/or teaching will likely identify those students who do not need the special programming, and they can be removed from those situations and replaced in their previous programming activities with a minimal disruption of their education.

Conclusions

It is possible to identify a screening battery from a larger set of variables which can predict the classification of students into learning disabled or not learning disabled groups. The screening batteries for both grades three and one contained measures of intelligence, reading, and mathematics ability. In addition, the third grade battery contained a measure of language ability, and the first grade battery contained

measures of development and possibly information processing.

Since the batteries were able to predict about one-half of the variance in a set of criterion scores, and were able to correctly classify about 80 - 90% of the students into known groups, the batteries may be useful in new settings. A second stage of research is indicated.

References

Beery, J. W. Matching of auditory and visual stimuli by average and retarded readers. Child Development, 1967, 38, 827-833.

Birch, H. Dyslexia and maturation of visual function. In Money, J. (ed.), Reading Disability: Progress and Research Needs in Dyslexia. Baltimore: Johns Hopkins Press, 1962.

Bryant, N. D. Diagnostic Test of Phonic Skills. Albany, N.Y.: State University of New York at Albany, Child Research and Study Center, 1963.

Chalfant, J. C., & Flathouse, V. E. Auditory and visual learning. In Myklebust, H. (ed.), Progress in Learning Disabilities, Vol. 2. New York: Grune and Stratton, 1971.

Chalfant, J. C., & Schefflin, M. A. Central processing dysfunctions in children: a review of research. NINDS monograph #9, Washington, D.C.: U. S. Department of Health, Education, and Welfare, 1969.

Connolly, A. J., Nachtman, W., & Pritchett, E. M. Key Math Diagnostic Arithmetic Test. Circle Pines, Minnesota: American Guidance Service, Inc., 1971.

Cruickshank, W. M. Some issues facing the field of learning disability. Journal of Learning Disabilities, 1972, 5, 380-383.

Dunn, L. M. Peabody Picture Vocabulary Test (Form B). Circle Pines, Minnesota: American Guidance Service, Inc., 1965.

Gallagher, J. Foreword. In Frostig, M., & Maslow, P. (eds.), Learning Problems in the Classroom. New York: Grune and Stratton, 1973.

Gilmore, J. V., & Gilmore, E. O. Gilmore Oral Reading Test. New York: Harcourt, Brace, and World, Inc., 1968.

Hieronymous, A. N., & Lindquist, E. F. Iowa Tests of Basic Skills. Boston: Houghton Mifflin Company, 1974.

Jones, J. P. Learning modalities: should they be considered? Paper presented at the annual convention of the International Reading Association, Atlantic City, New Jersey, 1971.

Keogh, B., & Becker, L. Early detection of learning problems: questions, cautions, and guidelines. Exceptional Children, September 1973, 5-10.

Kirk, S. A., McCarthy, J. J., & Kirk, W. D. Illinois Test of Psycholinguistic Abilities. Urbana, Illinois: University of Illinois Press, 1968.

Koppitz, E. M. The Bender Gestalt Test for Young Children. New York: Grune and Stratton, 1964.

McCarthy, D. McCarthy Scales of Children's Abilities. New York: The Psychological Corporation, 1972.

Meier, J. Learning disabilities found in elementary schools. In Satz, P., & Ross, J. (eds.), The Disabled Learner. Netherlands: Rotterdam University Press, 1973.

Moyer, S. C. Early Identification Screening Battery: Mathematics. Albany, N.Y.: State University of New York at Albany, Child Research and Study Center, 1976.

Murray, C. A. The Link Between Learning Disabilities and Juvenile De-

linquency. Washington, D.C.: U. S. Government Printing Office, 1976.

Nie, N. H., Hull, C. H., Jenkins, J. G., Steinbrenner, K., & Bent, D. H. Statistical Package for the Social Sciences. (2nd. ed.). New York: McGraw-Hill, 1975.

Santa Clara Unified School District. Inventory of Developmental Tasks. Santa Clara, CA: Author, undated.

Satz, P., Taylor, H. G., Friel, J., & Fletcher, J. M. Some developmental and predictive precursors of reading disabilities: a six-year follow-up. In Pearl, D., & Benton, A. (eds.), Dyslexia: An Appraisal of Current Research. Book in preparation, NIMH, 1977.

Slosson, R. L. Slosson Intelligence Test for Children and Adults. East Aurora, N.Y.: Slosson Educational Publications, Inc., 1963.

Steger, B. M. Early Identification Screening Battery: Reading. Albany, N.Y.: State University of New York at Albany, Child Research and Study Center, 1976.

Stevenson, H. W., Parker, T., Wilkinson, A., Hegion, A., & Fish, E. Longitudinal study of individual differences in cognitive development and scholastic achievement. Journal of Educational Psychology, 1976, 68, 377-400.

Tanzman, M. Word Association and Matching Task. Albany, N.Y.: State University of New York at Albany, Child Research and Study Center, 1976.

Vellutino, F.R. Alternative conceptualizations of dyslexia: evidence in support of a model of a verbal deficit hypothesis. Harvard Educational Review, 1977, 47, 334-354.

Vellutino, F. R., & Steger, B. M. Trial Teaching Task. Albany, N.Y.: State University of New York at Albany, Child Research and Study Center, 1976.

Vellutino, F. R., Steger, B. M., Moyer, S. C., Harding, C. J., & Niles, J. A. Has the perceptual deficit hypothesis led us astray? An examination of current conceptualizations in the assessment and treatment of exceptional children. Paper presented at the annual convention of the Council for Exceptional Children, New York, April 1974.

TABLE 1

COMBINED MEANS AND STANDARD DEVIATIONS FOR FOURTEEN VARIABLES ON THIRD GRADE CHILDREN[1]

No.	Variable	Mean	St. Dev.
1.	Slosson intelligence quotient (SIQ)	109.6	13.49
2.	PPVT intelligence quotient (PPVT)	107.9	15.69
3.	Gilmore Oral Reading accuracy score (GOR)	22.9	8.65
4.	Bryant Test of Phonic Skills raw score (BTPS)	21.1	6.65
5.	Key Math raw score (KEYM)	102.6	19.20
6.	Bender Visual Motor Gestalt error score (BVMG)	3.4	2.34
7.	ITPA Grammatic Closure raw score (ITPA)	25.9	3.86
8.	Word Association raw score (WARS)	41.2	3.87
9.	Word Association latency score (WALS)	281.2	109.07
10.	Matching raw score (MTCH)	26.2	3.75
11.	ITBS Vocabulary raw score (ITV)	15.8	6.23
12.	ITBS Reading Comprehension raw score (ITRC)	24.9	11.55
13.	ITBS Mathematics Concepts raw score (ITMC)	16.5	6.46
14.	ITBS Mathematics Problems raw score (ITMP)	11.8	5.18

[1] n = 70

TABLE 2

COMBINED MEANS AND STANDARD DEVIATIONS FOR TWENTY VARIABLES ON FIRST GRADE CHILDREN[1]

No.	Variable	Mean	SD
1.	Slosson intelligence quotient (SIQ)	117.0	13.72
2.	Peabody intelligence quotient (PPVT)	110.1	14.41
3.	Inventory of Developmental Tasks Copying (IDTC)	8.8	1.28
4.	Inventory of Developmental Tasks Matching (IDTM)	7.5	0.77
5.	Inventory of Developmental Tasks Total (IDTT)	16.3	1.52
6.	McCarthy Verbal Memory I (MSCA)	11.9	1.97
7.	Trial Teaching Task words (TTTW)	43.5	11.86
8.	Trial Teaching Task trials (TTTT)	11.2	4.48
9.	Word Association total (WARS)	29.7	11.52
10.	Word Association latency (WALS)	358.6	143.11
11.	Matching (MTCH)	21.3	3.19
12.	ITPA Grammatic Closure (ITPA)	18.9	4.29
13.	Mathematics screen (MATH)	39.3	7.91
14.	Reading screen (READ)	75.3	19.22
15.	ITBS Vocabulary (ITV)	14.0	6.51
16.	ITBS Word Analysis (ITWA)	31.3	7.79
17.	ITBS Reading (ITRC)	30.9	10.73
18.	ITBS Spelling (ITSP)	13.2	5.24
19.	ITBS Math concepts (ITMC)	19.0	4.71
20.	ITBS Math problems (ITMP)	11.6	4.34

[1] n = 71

TABLE 3

DISCRIMINANT ANALYSIS FOR GRADE THREE WITH TEN PREDICTORS AND TWO GROUPS

(1) LD Crit. PR[1]	(2) ITBS LD Variable	(3) Group Size LD	(4) Group Size Not LD	(5) Group Cent. Dist.	(6) Wilks' Lambda p <	(7) Order of Predictors Selected	(8) Canon. Corr.	(9) Classification Percent notLD	(9) Classification Percent LD
18	Vocab.	13	57	1.20	.012	3	.298	18	100
16	Reading	21	49	1.16	.001	3, 2, 7	.536	90	62
16	Math C.	20	50	1.07	.001	3, 5, 8	.490	90	50
15	Math P	19	51	1.14	.001	5, 10	.513	94	42
7	Vocab[2]	3	67	1.30	.176	8, 3, 7	.268	99	33
7	Reading[2]	15	55	0.97	.009	3, 6, 8	.401	96	27
6	Math C.	14	56	1.14	.003	3, 4, 5, 7	.462	95	21
9	Math P.[2]	14	56	1.31	.001	5, 6, 7	.527	96	50
3	Vocab.[2]	2	68	2.17	.023	2, 3, 4	.365	100	00
3	Reading[2]	6	64	1.50	.045	10,3,5,2,7,9	.424	100	33
2	Math C.[2]	10	60	1.13	.022	3, 4, 5, 9	.400	97	10
2.5	Math P.[2]	5	65	2.01	.001	3, 9, 7	.522	100	40

[1] Figured from the raw score closest to 1, 1.5, or 2 standard deviations below the mean (national norms).

[2] Cutoff score was below chance based upon answering all items in a random manner.

TABLE 4

DISCRIMINANT ANALYSIS FOR GRADE ONE WITH FOURTEEN PREDICTORS AND TWO GROUPS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
LD Crit. PR[1]	ITBS LD Variable	Group Size LD	Group Size Not LD	Group Cent. Dist.	Wilks' Lambda p <	Order of Predictors Selected	Canon. Corr.	Classification Percent notLD	LD
15	Vocab.	18	53	1.28	.001	14,4,10,6,1,13	.559	93	50
15	Word A.	12	59	1.25	.005	1,10,14,12,13	.470	97	25
16	Reading[2]	13	58	1.11	.008	14,9,8,13	.432	98	3
20	Spelling	30	41	1.03	.001	14,13	.560	83	63
17	Math C.	24	47	1.57	.001	13,6,5,12	.749	96	88
13	Math P.	28	43	1.35	.001	10,13,8,4,6,5,3,7	.663	88	75
9	Vocab.[2]	7	64	1.51	.019	14,1,13,7,11,3	.454	98	29
7	Word A.	3	68	2.14	.003	10,5,1	.434	99	33
7	Reading[2]	4	67	2.06	.004	13,2,9,5,7	.480	99	50
8	Spelling[2]	14	57	1.28	.002	14,7,11,2,12,10	.514	95	43
7	Math C.	8	63	2.19	.001	4,13,14,5,6,9,7,10	.700	100	88
5	Math P.	5	66	1.45	.037	5,11,9,7,	.376	100	20
4	Vocab.[2]	3	68	1.82	.083	11,7,13,3,1	.369	100	33
1	Word A.[2]	1	70	4.54	.002	10,4,2,7,8,6,3	.541	100	100
2	Reading [2]	2	69	2.35	.011	13,2,1	.391	100	50
2	Spelling[2]	1	70	2.14	.211	5,12,9	.254	100	00
2	Math C.[2]	2	69	2.01	.017	5,7	.336	100	50
2	Math P.[2]	3	68	2.40	.007	3,7,11,13,12,10	.487	99	67

[1] Figured from the raw score closest to 1, 1.5, or 2 standard deviations below the mean (national norms).

[2] Cutoff score was below chance based upon answering all items in a random manner.

TABLE 5

INFLUENCE OF SELECTED PREDICTORS ON DEPENDENT VARIABLES FOR GRADE THREE

(1) Dependent Variable	(2) Predictor Variables	(3) Mult. R Increase	(4) R Square Change	(5) Beta	(6) F for Set	(7) p <	(8) Adjusted R Square
ITBS Vocabulary	PPVT	.528	.279	.344[a]	21.63	.001	.545
	GOR	.751	.285	.516[a]			
	KEYM	.756	.007	.109			
	ITPA	.756	.000	-.009			
ITBS Reading	PPVT	.527	.277	.335[b]	16.86	.001	.479
	GOR	.691	.200	.399[a]			
	KEYM	.712	.030	.230			
	ITPA	.714	.002	-.059			
ITBS Math Concepts	PPVT	.388	.151	.083	16.74	.001	.477
	GOR	.577	.182	.273[b]			
	KEYM	.709	.170	.539[a]			
	ITPA	.712	.004	-.080			
ITBS Math Problems	PPVT	.326	.106	-.033	18.04	.001	.497
	GOR	.524	.168	.203[c]			
	KEYM	.725	.251	.640[a]			
	ITPA	.725	.001	-.032			

[a] $p < .001$

[b] $p < .01$

[c] $p < .05$

TABLE 6

INFLUENCE OF SELECTED PREDICTORS ON DEPENDENT VARIABLES FOR GRADE ONE

(1) Dependent Variable	(2) Predictor Variables	(3) Mult. R Increase	(4) R Square Change	(5) Beta	(6) F for Set	(7) p <	(8) Adjusted R Square
ITBS Vocabulary	SIQ	.404	.163	.056	9.23	.001	.459
	IDTC	.442	.032	.136			
	IDTM	.492	.047	-.074			
	WARS	.494	.002	.027			
	WAML	.496	.002	.028			
	MATH	.550	.056	.023			
	READ	.717	.212	.673[a]			
ITBS Word Analysis	SIQ	.554	.307	.287[c]	8.41	.001	.433
	IDTC	.575	.024	.171			
	IDTM	.601	.031	-.023			
	WARS	.606	.006	.081			
	WAML	.636	.037	-.210[c]			
	MATH	.642	.008	-.069			
	READ	.701	.079	.410[b]			
ITBS Reading	SIQ	.402	.162	-.102	11.42	.001	.518
	IDTC	.438	.030	.604			
	IDTM	.503	.061	-.090			
	WARS	.509	.006	.052			
	WAML	.513	.004	-.103			
	MATH	.662	.175	.355[c]			
	READ	.753	.129	.525[a]			
ITBS Spelling	SIQ	.351	.123	-.114	8.31	.001	.429
	IDTC	.393	.031	.123			
	IDTM	.522	.118	.069			
	WARS	.529	.007	.070			
	WAML	.536	.008	-.121			
	MATH	.610	.084	.181			
	READ	.699	.117	.499[a]			
ITBS Math Concepts	SIQ	.543	.295	.135	11.10	.001	.510
	IDTC	.584	.046	.093			
	IDTM	.629	.054	.025			
	WARS	.629	.000	-.030			
	WAML	.630	.002	-.078			
	MATH	.741	.153	.492[a]			
	READ	.748	.011	.153			
ITBS Math Problems	SIQ	.459	.210	.047	7.53	.001	.402
	IDTC	.505	.045	.094			
	IDTM	.515	.010	-.096			
	WARS	.521	.007	-.063			
	WAML	.567	.050	-.270			
	MATH	.681	.142	.543[a]			
	READ	.681	.000	.000			

[a] $p < .001$ [b] $p < .01$ [c] $p < .05$

TABLE 7

DISCRIMINANT FUNCTIONS FOR GRADE THREE WITH FOUR PREDICTORS AND TWO GROUPS

(1) LD Crit. Raw	(2) ITBS LD Variab.	(3) Group Sizes LD/NLD	(4) Group Cent. Dist.	(5) Wilks' Lambda p <	(6) Canon. Corr.	(7) Classification Percent NLD	(7) Classification Percent LD	(8) Discrim. Functn. Coeff. (Raw) B1	B2	B3	B4	C
9	Vocab.	13/57	1.236	.001	.484	97	31	-.009	-.100	-.002	-.037	4.359
16	Read.	21/49	.870	.001	.541	90	62	.040	..010	-.009	-.059	-4.195
12	Math C.	20/50	1.007	.004	.458	94	30	-.004	-.048	-.038	.011	5.155
7	Math P.	19/51	1.137	.001	.509	98	42	.003	-.022	-.042	-.048	5.775
7	Vocab.	3/67	1.150	.443	.235	100	00	-.020	.119	.004	-.154	3.024
13	Read.	15/65	.870	.058	.359	96	7	-.031	-.092	-.008	.074	4.341
9	Math C.	14/56	1.074	.008	.433	93	14	-.004	-.072	-.013	-.079	5.545
6	Math P.	14/56	1.228	.001	.495	98	50	.008	-.011	-.040	-.098	6.072
5	Vocab.	2/68	2.071	.075	.348	100	00	-.019	.128	-.016	-.088	3.051
11	Read.	6/64	1.137	.128	.321	100	00	.048	.109	-.029	-.151	-3.742
7	Math C.	10/60	1.043	.048	.368	100	10	.001	-.054	-.023	-.092	5.860
4	Math P.	5/65	1.836	.002	.476	100	20	-.009	-.048	-.020	-.091	6.519

Y = (B1)(PPVT) + (B2)(GOR) + (B3)(KEYM) +(B4)(ITPA) + C

If Y is above LD Crit. Raw, then assign to NLD group; otherwise assign to LD group.

TABLE 8

DISCRIMINANT FUNCTIONS FOR GRADE ONE WITH SEVEN PREDICTORS AND TWO GROUPS

(1) LD Crit Raw	(2) ITBS LD Var.	(3) Group Sizes LD/NLD	(4) Group Cent. Dist.	(5) λ p <	(6) Can. Cor.	(7) Classif. Percent NLB	(7) Classif. Percent LD	(8) Discriminant Function Coefficients (Raw) B1	B2	B3	B4	B5	B6	B7	C
8	Voc.	18/53	1.239	.002	.543	91	50	.019	-.097	-.647	.006	-.001	-.037	-.027	7.371
23	WA	12/59	1.204	.034	.454	97	42	.045	.119	.138	-.012	-.003	-.046	.026	-6.054
22	Rdg.	13/58	1.049	.101	.409	95	23	.009	-.097	.113	.054	.001	-.072	-.029	2.181
10	Spel	30/41	1.134	.001	.565	83	60	.009	.053	-.034	-.002	.000	-.047	-.040	3.491
16	MC	24/47	1.541	.001	.734	92	88	-.018	-.099	-.103	.013	.000	-.098	.000	7.132
9	MP	28/43	1.155	.001	.568	84	61	-.008	-.199	.297	-.018	.005	-.073	.008	1.609
6	Voc.	7/64	1.391	.084	.418	95	29	.052	.146	-.424	-.005	.000	-.071	-.030	0.916
18	WA	3/68	2.144	.057	.434	99	33	.043	-.301	-.343	.001	-.005	-.007	.001	2.280
18	Rdg.	4/67	1.778	.093	.413	99	25	.033	.401	.327	.042	-.001	-.164	.010	-5.114
8	Spel	14/57	1.063	.069	.426	95	29	-.002	.088	-.181	.016	.002	.012	-.047	2.664
13	MC	8/63	2.087	.001	.665	98	75	-.007	.227	-.847	.024	.000	-.105	.021	7.149
6	MP	5/66	1.200	.474	.309	99	20	-.000	-.547	-.047	.040	.001	.012	-.033	5.875
4	Voc.	3/68	1.285	.709	.260	100	00	.053	.384	-.003	.022	-.003	-.087	-.023	-4.066
10	WA	1/70	3.819	.035	.453	100	100	-.022	.220	.733	-.012	.006	-.001	-.004	-6.339
13	Rdg.	2/69	2.276	.179	.379	100	50	.057	.114	-.217	.018	.000	-.165	.020	-1.732
5	Spel	1/70	2.056	.777	.244	99	00	-.014	.551	.908	.062	.000	-.102	-.003	-7.891
11	MC	2/69	2.192	.227	.365	99	50	-.040	-.439	.017	.051	-.001	.004	-.022	8.813
4	MP	3/68	1.616	.386	.327	99	00	-.005	.774	.136	-.018	-.002	-.012	.001	-5.654

Y = (B1) (SIQ) + (B2) (IDTC) + (B3) (ITDM) + (B4) (WARS) + (B5) (WAML) + (B6) (MATH) + (B7) (READ) + C

If Y is above LD Crit Raw, then assign to NLD group; otherwise assign to LD group.